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Nervous System: Claude Shannon's Magic Mouse and the Beginnings of Artificial Intelligence

More than 60 years ago, when digital computers that could do rote and automated tasks were still gaining acceptance, pioneering information theorist Claude Shannon announced he had successfully built a machine capable of learning from its mistakes and teaching itself how to improve.

BY DAVID KALAT, BRG

With the aggressive pace of technological change and the onslaught of news regarding data breaches, cyber-attacks, and technological threats to privacy and security, it is easy to assume these are fundamentally new threats. The pace of technological change is slower than it feels, and many seemingly new categories of threats have actually been with us longer than we remember. Nervous System is a monthly blog that approaches issues of data privacy and cybersecurity from the context of history—to look to the past for clues about how to interpret the present and prepare for the future.

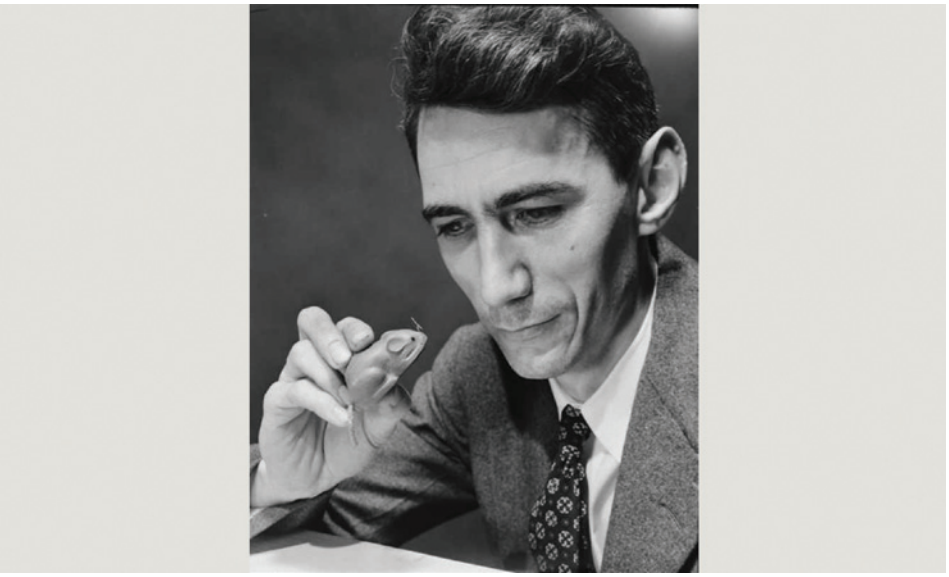

Photo: Wikipedia

Claude Elwood Shannon was an American mathematician, electrical engineer, and cryptographer known as "the father of information theory."

In 1950, pioneering information theorist Claude Shannon engineered a mechanical mouse that navigated a maze to find a hunk of metal "cheese." The project had started as a glorified toy, inspired in part by Shannon's having gotten lost in a hedge maze, but it was a bombshell announcement to the general public that had scarcely begun to accept the idea of digital computers that could do rote and automated tasks. Here was one of the fathers of computer science casually announcing that he had successfully built a machine capable of *learning* from its mistakes and *teaching* itself how to improve.

This was not the first time that Shannon had shaken up the world of ideas. His master's thesis at the Massachusetts Institute of Technology had laid the foundation of modern computing by demonstrating that electric relay circuits could perform Boolean algebra and execute any logical operation. He devised the concept of the "bit": the binary digit at the heart of computing. He invented information theory, the central idea behind protecting the integrity of a signal on a noisy channel. His work stands at the bedrock of computer science, telecommunications and cryptography.

Now he had turned his attention to robotic intelligence.

Shannon's mouse was playfully named Theseus, after the Greek hero who navigated the Labyrinth to battle the Minotaur. The metal mouse piloted its way through a grid that could be configured in many different possible layouts. Every time it encountered an obstacle, it rerouted itself until it found a clear path—and left behind a record of that decision in the electrical relay at that juncture.

Eventually, the lump of metal achieved its goal, arriving at the magnetic "cheese." A bell rang, and lights flashed. Then, Shannon plucked the robotic critter out and placed it back in the maze—perhaps at the start, but not necessarily. Here was the startling part—the mouse would now make a direct, unerring path to the cheese. It had "learned."

Plunk the mouse into a different part of the maze, or reconfigure the maze, and the mouse would use what of its memory still mattered and deploy new trial-and-error learning to map out the rest.

Shannon also programmed what he called an "anti-neurotic circuit" to protect the mouse from getting stuck in an endless loop—if it tried the same sequence of steps six times in a row without success, it would abandon its primary algorithm and switch to a "Plan B."

Pedants might quibble that the mouse was not solving the maze. Rather, the seventy-five electromagnetic relays built into the maze were recording the solution, and the mouse was nothing more than a visual gimmick, a prop. Shannon would not have disagreed—the point was that this was an information system that, by itself and with no outside input, *created*, *remembered*, and *used* information, and could *add* to that knowledge with additional experience. Until this point in time, such things had only ever been the province of living beings.

The principle could be repackaged easily in myriad forms and encased inside robotic shells. In fact, today's robotic vacuums, drone warriors, bomb-disposal robots, and self-driving cars rely on the foundational technology that Shannon demonstrated in his magic mouse.

Bell Laboratories recognized the importance of the project and made a short film to publicize it to the wider world. The press was intrigued. *Time* magazine published an article, "Mouse with a Memory," and *Popular Science* went with the more bombastic (and inaccurate) title "This Mouse Is Smarter Than You Are."

Most significant, Theseus and Shannon were the highlight of a 1951 conference on artificial intelligence.

From 1941 and 1960, the Josiah Macy Jr. Foundation sponsored a series of interdisciplinary scientific conferences in New York intended to foster communication and collaboration among specialists who might otherwise have little interaction. The 1951 conference focused on artificial intelligence. For most scientists and researchers in 1951, "artificial intelligence" was an exciting idea that attracted theorists and big thinkers to debate how one might try to engineer such a thing, what it might look like if it existed, and what sort of implications such a development might have on human society.

It was a shock to the other attendees that Shannon arrived at the conference with an actual, concrete prototype. Suddenly, the rest of the world discovered that artificial intelligence was not some speculative science fiction, but instead was part of the here and now.

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